REMARKS

By this amendment, claim 19 has been cancelled, claims 1, 2, 5, 6, 8-10, 15-18, and 23-25 have been amended, and new claim 28 has been added. Accordingly, claims 1-18 and 20-28 are pending in the present application. Support for the claim amendments and new claim can be found in the application and claims as filed, in particular at page 10, line 22 to page 11, line 3 and at page 15, line 23 to page 16, line 21 and. The amendments to the specification correct minor typographical errors. Accordingly, favorable reconsideration of the pending claims is respectfully requested.

1. Rejections Under the Judicially Created Doctrine of Double Patenting

Claims 1-27 have been rejected under the judicially created doctrine of obviousness-type double patenting over claims 1-46 of U.S. Patent No. 6,150,257 to Yin et al. for the reasons set forth on page 2 of the Office Action.

This rejection will be addressed when allowable subject mater has been indicated by the Examiner.

2. Rejections Under 35 U.S.C. §103

Claims 1, 2, and 5-27 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 5,529,954 to Iijima et al. (hereinafter "*Iijima*") taken with U.S. Patent No. 5,633,200 to Hu (hereinafter "*Hu*") for the reasons set forth on pages 4-5 of the Office Action. Applicants respectfully traverse.

Independent claims 1, 6, 16, 20, 24, and 25 have been amended to recite some form of

the limitation: "reacting a chemical composition with from about 1 to about 1,000 atomic lattice layers of said upper surface to form a passivating layer over the upper surface." In addition, present claims 6, 7, 10, 12, 15, and 23 recite a passivation layer thickness of either less than about 50 Å or in a range from about 2 Å to about 20 Å. Accordingly, each of the pending claims, save only claims 17 and 18, recite a passivation layer thickness in some form. The reason for these relatively thin layers comes directly from the use of the passivation layers to passivate, or "blind off," the surface of a tungsten interconnect. As noted in the specification:

> The chemical compound is provided in an amount sufficient to substantially chemically cover upper surface 16 of interconnect 12 in order to chemically protect approximately **the first 1-1,000 atomic lattice layers** thereof.
>
> * * *
>
> The chemical compound may be, by way of non-limiting example, the nitrogen-containing chemical compound such as ammonia that has been adsorbed onto upper surface 16 of interconnect 12 sufficiently to **substantially chemically cover or "blind off" substantially any chemically reactive portion of upper surface 16 of interconnect 12** during formation of ILD layer 18.

Specification at page 10, lines 4-14 (emphasis added). These thin layer thicknesses are not conventional in the art because they would not suit any heretofore disclosed use for the passivation layers. While it is true that forming a nitride film on a tungsten layer has been performed before, it was previously done for different reasons, by different methods, and with different results.

For example, *Hu* discloses physical vapor deposition processes to form large grain

tungsten nitride films for use as a diffusion barrier. Col. 8, lines 19-23. Thus, the only disclosed thickness for the tungsten nitride film is 100 nm (1,000 Å). Col. 9, lines 47-50. Also in contrast to the present thin passivation layers, *Iijima* performs an anneal to form discrete TiO_2, TiN, and MgN_x layers that are sufficiently thick to be used as an etch stop (Col. 6, lines 40-41) and prevent silver agglomeration (Col. 6, lines 26-31). In fact, the minimum thickness of these layers is 150 Å (Col. 11, lines 14-16), which is several times the maximum thickness disclosed in the application. Assuming, *arguendo*, that these prior art references teach methods that might possibly create layers as thin as those presently claimed, there is simply no teaching in the prior art or motivation for one skilled in the art to do so. Further, the presently claimed methods would not be attained by any routine optimization because, as previously noted, prior art methods were focused on different goals that required thicker layers.

Next, claims 5, 15, 17, and 18, have been amended to recite some form of the limitation: "wherein the step of forming the passivation layer comprises heating said first dielectric layer to a first temperature and thereafter heating said first dielectric layer to a second temperature, wherein the first temperature is less favorable to the formation of an oxide husk on said upper surface than the second temperature." Additionally, claims 17, 18, and 23, have been further amended to recite some form of the limitations: "the step of forming the passivation layer further comprises: exposing the upper surface to a plasma having a first concentration of a chemical composition used to form the passivation layer; and incrementally reducing the concentration of the chemical composition until it is completely removed from the presence of the upper surface." Support for these amendments can be found in the application as filed at page 10, line 22 to page 11, line 3. *Iijima* and *Hu* do not teach or

suggest these limitations.

Claim 15 recites, *inter* alia:

> *in situ* forming:
>
> a passivation layer composed of tungsten nitride, disposed upon said upper surface, and having a thickness of less than about 50 Å, wherein the step of forming the passivation layer comprises heating said first dielectric layer to a first temperature and thereafter heating said first dielectric layer to a second temperature, wherein the first temperature is less favorable to the formation of an oxide husk on said upper surface than the second temperature; and
>
> an ILD disposed upon said dielectric layer and upon said upper surface, said ILD being continuously adhered to said upper surface.

In addition to the foregoing reasons for claim 15's patentability, neither of *Iijima* and *Hu* (nor *Aoyama* as well), disclose such a process of *in* situ adjustment of temperatures during the formation of a passivation layer having a thickness of less than about 50 Å.

Regarding claims 13, 16, 21, and 24, *Iijima* and *Hu* do not teach or suggest multiple passivation layers, let alone a first passivation layer comprising a tungsten nitride film and a second passivation layer comprising ammonia and its derivatives that is adsorbed onto the first passivation layer.

Therefore, the combination of *Iijima* with *Hu* fails to teach or suggest the limitations of claims 1, 2, and 5-25, and the withdrawal of this rejection is respectfully requested.

Claims 3 and 4 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over *Iijima* taken with *Hu* and further in view of U.S. Patent No. 5,592,024 to Aoyama et al. (hereinafter "*Aoyama*") for the reasons set forth on page 5 of the Office Action. Applicants respectfully traverse.

Claims 3 and 4 depend from claim 1 and thus include the limitations thereof, including

the specific limitations of "reacting a chemical composition with from about 1 to about 1,000 atomic lattice layers of said upper surface to form a passivating layer over the upper surface." In addition to being absent from *Iijima* and *Hu*, such a limitation is also not taught or suggested in *Aoyama*. Thus, even if the cited references are combined as suggested by the Examiner, not all of the claim limitations are met.

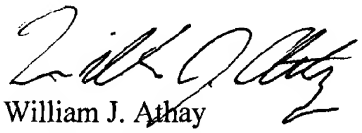
Accordingly, Applicants therefore respectfully request that the rejection of claims 1-25 under 35 U.S.C. § 103(a) be withdrawn.

CONCLUSION

In view of the foregoing, Applicants respectfully request favorable reconsideration and allowance of the present claims. In the event the Examiner finds any remaining impediment to the prompt allowance of this application that could be clarified by a telephone interview, the Examiner is respectfully requested to contact the undersigned attorney.

Dated this 17th day of April, 2003.

Respectfully submitted,



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